Exercise	1	2	3	Total	
100%	7	5	4	16	
Points					

Name:

Stellar Astrophysics

Homework - Lecture 17 - The Sun and star formation

Due date: November 8

1 Solar Flares

Assume that a large solar flare erupts in a region where the magnetic field strength is $B = 300\,\mathrm{G}$ and it releases $10^{32}\,\mathrm{erg}$ in one hour.

1. What was the magnetic energy density in that region before the eruption began?
2. What minimum volume would be required to supply the magnetic energy necessary to fuel the flare?
3. Assuming for simplicity that the volume involved in supplying the energy for the flare eruption was a cube, compare the length of one side of the cube with the typical size of a large flare (about $10^5\,\mathrm{km}$).
4. What can you conclude about the assumption that magnetic energy is the source of solar flares, given the physical dimensions and time scales involved?

Look into Section 11.2 and 11.3 in Carroll & Ostlie in case you have problems with the exercise.

2 Zeeman Effect

1. Calculate the frequency shift produced by the normal Zeeman effect in the center of a sunspot that has a magnetic field strength of $B = 3000\,\mathrm{G}$.
2. By what fraction would the wavelength of one component of the 6302.5 Å FeI spectral line change due to a magnetic field of $B = 3000\,\mathrm{G}$?

3 Molecular Cloud

Assume a giant molecular cloud with $T = 150\,\mathrm{K}$ and particle density $n = 10^8\,\mathrm{cm}^{-3}$. Assume that the cloud is entirely composed of HI.

1. Calculate the Jeans length and Jeans mass for this molecular cloud.
2. Estimate the gravitational energy per unit volume in the cloud and compare that with the magnetic energy density that would be contained in the cloud if it has a magnetic field of uniform strength, $B = 10\,\mu\mathrm{G}$. Could magnetic fields play a significant role in the collapse of a cloud?

Look into Chapter 12 in Carroll & Ostlie in case you have problems with the exercise.